Assimilation of GOES-R ABI Aerosol Optical Depth (AOD) in a Regional Air Quality Model to Improve Surface PM2.5 Forecasts
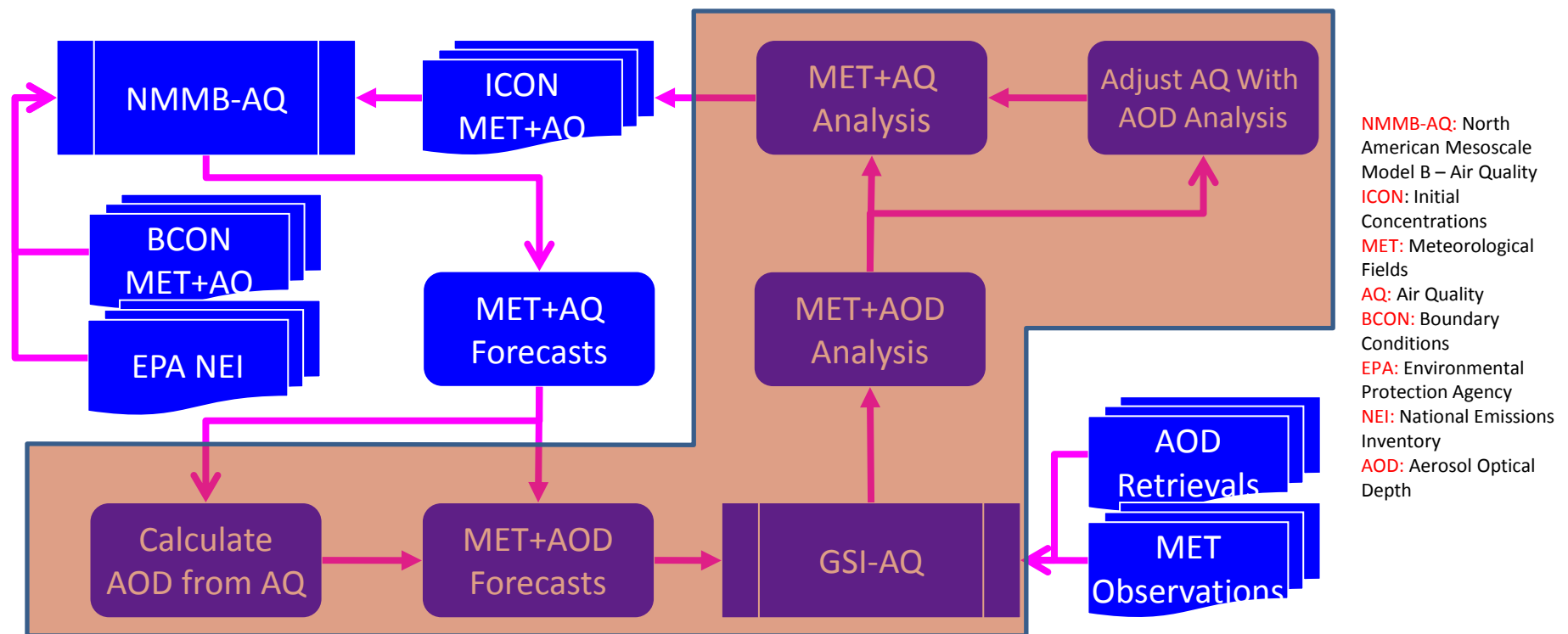
S. Kondragunta, NOAA/NESDIS/STAR

Q. Zhao, IMSG

GOES-R Risk Reduction Review , September 23, 2011

Objective

- In preparation for GOES-R products, build a GOES AOD assimilation system in Gridpoint Statistical Interpolation (GSI) framework.

- Transition the assimilation system to NCEP operations

NMMB-AQ: North American Mesoscale Model B – Air Quality
ICON: Initial Concentrations
MET: Meteorological Fields
AQ: Air Quality
BCON: Boundary Conditions
EPA: Environmental Protection Agency
NEI: National Emissions Inventory
AOD: Aerosol Optical Depth

FY11 Accomplishments

- Completed code development to convert GOES AOD data into BUFR format. BUFR encoder/decoder work for GOES-11, GOES-12, and GOES-13.
- Code easily adaptable for other satellites.
- Developed post-processing code to handle multiple Community Multiscale Air Quality (CMAQ) model output files.
- Completed GSI code development
  - A branch was created in NCEP GSI subversion repository where developed code is committed
  - GSI GOES AOD product read module
  - CMAQ aerosol property module. Uses CRTM to compute AOD from CMAQ model aerosol fields
  - Code to convert C-grid met variables to A-grid
  - Code to compute CMAQ first guess fields
  - Tested compiling and running GSI with CMAQ NEMSIO data file and GOES AOD BUFR dataset as inputs

Categorical Evaluation for CMAQ Data Assimilation Experiments

- ✓ Accuracy (A)
- ✓ Bias (B)
- ✓ False Alarm Rate (F)
- ✓ False Alarm Ratio (FAR)
- ✓ Critical Success Index (CSI)
- ✓ Hit rate (H) or Probability of Detection (POD)

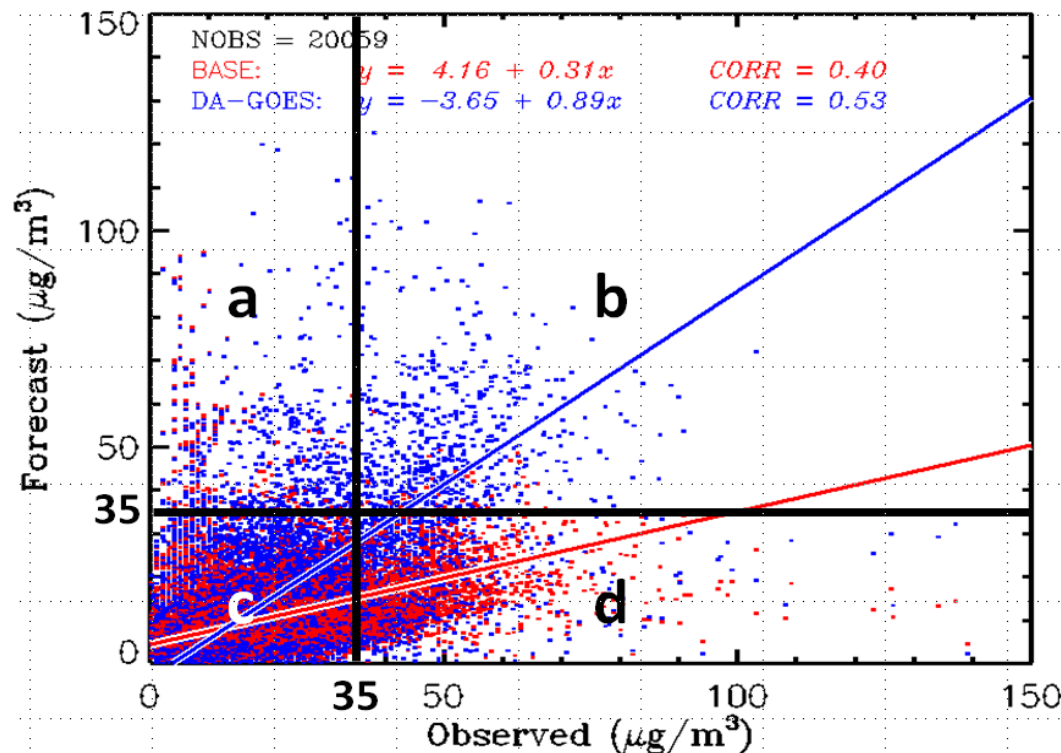$$A = \left(\frac{b + c}{a + b + c + d} \right) \cdot 100\%$$

$$B = \frac{a + b}{b + d}$$

$$F = \left(\frac{a}{a + c} \right) \cdot 100\%$$

$$FAR = \left(\frac{a}{a + b} \right) \cdot 100\%$$

$$CSI = \left(\frac{a}{a + b + d} \right) \cdot 100\%$$

$$H = POD = \left(\frac{b}{b + d} \right) \cdot 100\%$$

NOBS = 20059
BASE: y = 4.16 + 0.31x   CORR = 0.40
DA−GOES: y = −3.65 + 0.89x   CORR = 0.53

FY12 Tasks

- Complete GSI development (delayed due to STAR contract vehicle issues)

  - Generate CMAQ model AOD background error (BE) statistics

  - Generate GOES AOD observation error (OE) statistics

  - Integrate CMAQ AOD BE and GOES AOD OE covariance matrices into GSI system through cost function construction

- Conduct data assimilation experiments with GSI and analyze the results

  - GOES AOD data

  - GOES-R proxy data

- Complete a manuscript on GOES AOD assimilation work (in preparation)